Business Case Analysis for Microchip Logistics

DL104T1

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Executive Summary

The flow of hazardous materials (HAZMAT) in the Defense Logistics Agency (DLA) supply chain suffers from inaccurate or missing product information. Two of the busiest DLA HAZMAT depots report that approximately 95 percent of the HAZMAT shipments received require additional research because of missing information. Resolving the interruptions requires manually-intensive research and work-arounds. DLA is considering the use of an automatic data collection system to improve item tracking and access to product information. This study examines current HAZMAT handling procedures and analyzes the potential improvements of implementing a radio frequency tag system.

The radio frequency identification system under DLA consideration is Microchip Logistics (MICLOG), which uses radio frequency tags and automatic readers to provide instant recognition of products and automatically collect item-specific information as material travels through the supply system.

In this business case analysis, the Logistics Management Institute examines HAZMAT supply chain activities including identification, receipt, handling, storage, and shipment of materials. We document costs in the current process and potential improvements if the MICLOG system is implemented.

Our analysis indicates that the overall benefits of implementing MICLOG to the DLA HAZMAT supply chain could be substantial. In comparison to the status quo, combined potential savings for DLA depots, containerization and consolidation points, and military service customers could be approximately $5.5 million a year after an estimated 5-year implementation. The savings come from elimination of additional labor and resources used to research missing HAZMAT product information and associated manual data collection and entry required for material induction.

We projected cash flow over a 15-year span from the beginning of the 5-year implementation to 10 years after full implementation. The calculated projected net present value of the program is $25.4 million.

Our sensitivity analysis examined five key parameters that could affect the success of the program:

- Cost of the radio frequency identification (RFID) tag
- Average number of RFID tags required per requisition
- Number of HAZMAT vendors
- Volume of DLA HAZMAT supply chain shipments
- Implementation costs.

Based on our results, we are confident that the initiative will produce a positive net present value if the implemented operation is similar to the concept in this report. However, if several key parameters vary to produce undesirable changes simultaneously, the realization of these potential benefits is jeopardized. We recommend that each key parameter be monitored closely during development and implementation.

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Introduction

PURPOSE

The flow of hazardous materials (HAZMAT) in the Defense Logistics Agency (DLA) supply chain suffers from inaccurate or missing product information. Resolving the problems requires expensive, manually intensive research and workarounds.

One possible solution is implementation of Microchip Logistics (MICLOG), a data collection system designed to provide instant recognition of products and item-specific information as the material passes through the supply chain by using radio frequency tags and automatic readers.

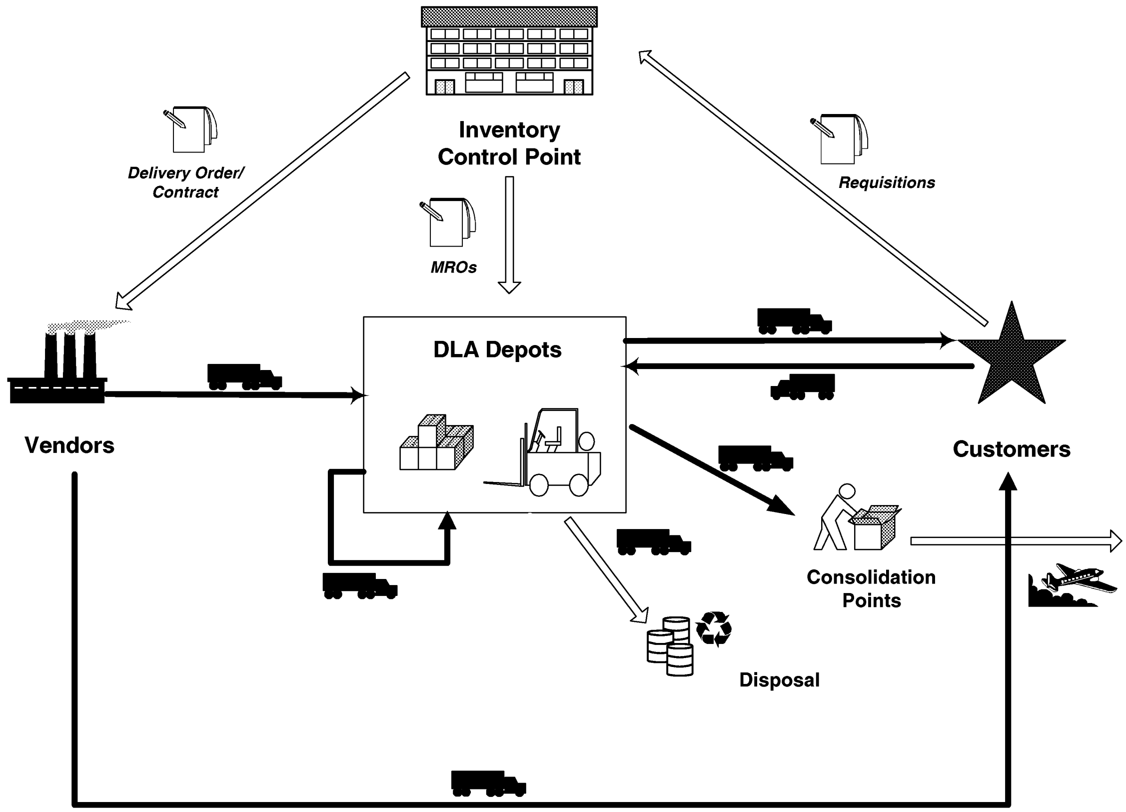
In this report, Logistics Management Institute (LMI) presents a business case analysis (BCA) of MICLOG that examines the potential effects on the DLA Hazardous Material supply chain. In the analysis, we examine activities throughout the supply chain including identification, receipt, handling, storage, and shipment of materials. We document the current process and compare it to potential improvements using MICLOG. Our economic assessment estimates the cost of MICLOG implementation and quantifies the benefits of efficiencies gained in process improvements.

Our sensitivity analysis examined five key parameters that could affect the success of the program:

- Cost of the radio frequency identification (RFID) tag
- Average number of RFID tags required per requisition
- Number of vendors
- Volume of DLA supply chain shipments
- Implementation costs.

To meet schedule and budget requirements, our assessment is limited to the continental United States (CONUS) DLA hazardous material (HAZMAT) supply chain including direct suppliers to DLA, distribution depots, military service locations that are DLA customers, containerization and consolidation points (CCPs), and disposal activities. Figure 1-1 illustrates this supply chain.

Figure 1-1. DLA HAZMAT Supply Chain



REPORT ORGANIZATION

In Chapter 2, we provide background on the problems in the supply chain and the search for a solution. In Chapter 3, we describe the assumptions we made in our analysis of the alternatives. We describe the alternatives in Chapter 4. In Chapter 5, we present our findings and cost analysis. Chapter 6 contains a summary and our recommendation. Our baseline financial analysis is in Appendix A. Our sensitivity analysis is in Appendix B. Appendix C contains a list of abbreviations.

Chapter 2
Background

Four continental United States depots handle more than 75 percent of HAZMAT shipments from vendors. Because of extensive regulatory requirements for hazardous materials, HAZMAT handling processes at these four depots are often seriously interrupted. In many cases, missing or inaccurate product information causes the interruptions.

An example of the cause of interruptions is missing Material Safety Data Sheets (MSDS) that contain product information required to induct and handle hazardous materials. In current practice, a hardcopy of the MSDS is supposed to be included in the shipping documentation. Unfortunately, shipments frequently arrive at DLA depots and service installations without an MSDS document or incomplete MSDS data because it was lost during shipment, removed at central receiving before reaching the HAZMAT storage warehouse, sent separately from the shipment, or any number of other reasons. Two of the busiest DLA HAZMAT depots report that more than 95 percent of the HAZMAT shipments received require additional research because of missing MSDSs or the MSDS furnished did not provide complete data. The receiving points have few resources available to gather missing information, and the recovery process is labor intensive, inefficient, and costly.

The Department of Defense (DoD) Defense Logistics Agency has investigated the use of RFIDs and associated commercial off-the-shelf microchip devices through the Advanced HAZMAT Rapid Identification, Sorting, and Tracking (AHRIST) program. The goal of the investigation is to find a technology to improve HAZMAT material transportation and handling throughout the DLA distribution system and the DoD logistics supply chain.

The AHRIST program has two phases. Phase 1, testing candidate RFID devices for comparison in a controlled laboratory environment, is complete. During phase 1, a real-time demonstration in the New Cumberland, Pennsylvania, distribution depot proved the feasibility of advanced microchip technology in HAZMAT distribution.

In phase 2, an operational prototype will incorporate a supplier, transporter, commercial customer, and military customer to evaluate the performance and operational capabilities of commercial radio frequency technology systems in the DoD supply chain environment. This information will aid in the further definition of potential operational concepts and technical requirements for implementation of the technology.

In this analysis, we identify and quantify the effects of purchasing, installing, operating, and maintaining RFID technologies as a standard identification, tracking, and sorting device in the HAZMAT supply chain. Our analysis also estimates the potential efficiencies of the technology in HAZMAT supply chain operations.

We visited two of the four leading DLA HAZMAT depots—Defense Supply Center, Richmond, and Defense Supply Center, San Joaquin—where we interviewed warehouse personnel and observed receiving, induction, and shipment processes. We contacted the other two leading HAZMAT depots—Defense Supply Center, New Cumberland, and Defense Supply Center, Hill—to gather similar information. We also visited the Containerization and Consolidation Point (CCP) in Tracy, California, and we interviewed personnel at the CCP in New Cumberland, Pennsylvania. We surveyed several DoD HAZMAT vendors to learn of their HAZMAT shipment and labeling procedures. In addition, we surveyed several service customers about their processes for identification, receipt, storage, and shipment of HAZMAT. For historical data, we were able to use historical data files provided by the DLA Office of Operations Research Analysis (DORRA) for our analysis.

Chapter 3
Assumptions

For our analysis, we use several assumptions that could influence the outcome of the proposed MICLOG program. Some assumptions are internal, and the effect of an incorrect assumption could be mitigated with effective program management and adequate resources. External assumptions fall outside the purview of MICLOG program management. Following is a list of the external assumptions we used in our analysis of the costs and potential benefits of a MICLOG implementation:

- Adequate technology and industrial base
- Data accuracy
- Implementation timing
- Vendor acceptance
- Study information
- Tag placement requirements.

We describe these factors in the following section.

Adequate Technology and Industrial Base

The success of the MICLOG effort depends on advances in the technological capability of the RFID tag to maintain the integrity of stored data in various harsh environments. Equipment with the capability to accurately read the RFID tags within seconds must be available. These requirements strain the current limits of available components. We assume that RFID tags and readers with the required operational characteristics can be identified through either technological advances or changes to the current design of available systems.

In addition, there must be a viable industrial base to economically support the vendors, depots, customers, and all other supply chain entities. We assume that there will be an adequate industrial base in place to support the need for RFID tags, printers, portals, and other elements associated with the implementation of this technology.

DATA ACCURACY

Vendors, depots, and customers must be able to provide or upload sufficient, reliable information. We assume there will be no need to separately monitor data submissions for completeness and accuracy, or for a third party to independently verify the uploaded data.

IMPLEMENTATION TIMING

We assume that implementation of the technology will proliferate throughout the supply chain on a schedule similar to the one considered in this study.

VENDOR ACCEPTANCE

In this BCA, we address and estimate costs vendors will incur in adapting processes to apply this technology. We assume that vendors will agree to adapt their processes to accommodate this technology at no additional cost to the government than those addressed in this study.

STUDY INFORMATION

There is little scientific, statistical, or verifiable data for some of the estimates used in this study. Much of the information is based on expert opinion. We assume that the information collected is a close representation of actual operations.

TAG PLACEMENT REQUIREMENTS

The optimal placement of RFID tags is under study. For example, tags can be placed on each item unit, each item-packing unit, each box, each pallet, each order, or any combination of these placements. In this analysis, we assume that a tag is placed at the item order level so that each receipt by the depot, CCP, or service customer has one RFID tag available with all the information required to induct all of the items in that order.

These are the primary general assumptions that were made in conducting our analysis. If these assumptions prove wrong, there is additional risk to meeting the cost and benefit projections resulting from this analysis.

In the next chapter, we compare the two alternatives, maintaining status quo and implementing MICLOG.

Chapter 4
The Alternatives

For our business case analysis we set up two alternatives:

- Alternative 1—Maintaining status quo
- Alternative 2—Implementing MICLOG.

ALTERNATIVE 1—STATUS QUO

In our analysis of Alternative 1, we considered current processes from the perspective of vendors, depots, and CCPs.

Vendors

To identify DLA vendors, we used storage mission codes to identify DoD HAZMAT products, and a DoD procurement database to identify the suppliers of these products. This approach yielded approximately 1,400 potential HAZMAT vendors that have been under contract to DLA and DoD services in the past 3 years. We used the list of suppliers for a telephone survey that we conducted between January and March 2001. Survey respondents typically were owners or presidents of small companies, shipping and transportation specialists, or defense business managers. We contacted 45 companies; however, 20 contacts[1] were unable to provide data because they

- do not currently ship hazardous material from their facility, and have no requirement for an MSDS (n=16);
- no longer provide products to DoD (n=2);
- provided references to supplier (n=1); and
- research and development location (n=1).

The results of the survey showed that of the 45 vendors contacted, about 40 percent (20 of 45, or 44.4 percent) are not involved with shipping hazardous material. When we apply the 40 percent to the overall 1,400 potential DoD HAZMAT vendors, we estimate the number of DoD and DLA HAZMAT suppliers is 840. Table 4-1 lists the 25 respondents that provided us with useful information.

[1] We use the notation, "n=*x*" to indicate the number of respondents.

Table 4-1. Surveyed Vendors Providing Useful Responses

Vendor name	Cage	Location	Product
Awosco	06WC3	Baltimore, MD	Electronic products
Barnes PSP Inc.	17705	Butler, PA	Tire bonding compound and repair kits
Black and Company	00WU8	Indianapolis, IN	Carbon removing compounds
Bren-Tronics	51828	Commack, NY	Storage batteries
Bushwacker Backpack Supply	082C9	Kalispell, MT	Pepper spray
Chempac of Tampa	071W3	Tampa, FL	Chemicals
Drexel Industries	07443	Horsham, PA	Batteries, paints, forklifts
Eldorado Chemical Co.	55208	San Antonio, TX	Cleaning compounds
Exide Corp.	20038	Reading, PA	Storage batteries
Exxon Corporation	29700	Houston, TX	Lubricating oils
Halocarbon Products	07644	River Edge, NJ	Fluoro-chemicals
Hawker Eternacell	5G978	Elmwood Park, NJ	Dry batteries
Home Oil Company	0A9L8	Wichita, KS	Isopropyl alcohol, fog oil
Leader Automotive	06XY2	Glenview, IL	Automotive supplies, lubricants
Litton Systems Electron Devices	89146	Williamsport, PA	Electron tubes
Metalcraft Inc.	06535	Baltimore, MD	Monobromotrifluoromethane, carbon dioxide
Mine Safety Appliances	55799	Evan City, PA	Oxygen canisters, chlorate candles
Orbital Sciences Corp.	86360	Germantown, MD	Programmable cartridges
Pacific Scientific	05167	Duarte, CA	Fire extinguishers
Puritan Products	0TG10	Bethlehem, PA	Nitric acid
QPL Inc.	0AD61	Thibodaux, LA	Acetone, isopropyl alcohol, solvents
Quick Start Products	78280	Rochelle, IL	Engine starting cylinders
Saft America Lithium Military Division	7X634	Valdese, NC	Batteries
Saft America Transportation Division	09052	Valdosta, CA	Batteries
Thermoflow	08CF1	Las Vegas, NV	Antifreeze

To determine the role vendors have in the supply chain, we considered the following vendor activities:

- Shipping documentation and labeling preparation
- Packing and labeling cells
- Business considerations.

Shipping Documentation and Labeling Preparation

Shipping documentation and labeling requirements for DoD HAZMAT and non-DoD HAZMAT shipments are similar, and they place minimal burden on the vendor.

In most cases, we found that the following shipping documents are assembled in hardcopy, placed in an envelope, affixed to the outermost container, and provided to the transport driver (in some cases, DoD and commercial customers require that elements of the documentation also be placed within intermediate containers):

- Packing list or commercial bill of lading with reference number; number of cartons, skids, or pallets; weight, contents, and carrier name.
- MSDS affixed to the outermost container or pallet and a hardcopy provided to the transport driver (also, an MSDS sometimes may be required inside intermediate containers).
- Emergency Response Guide or 1-800 emergency response number.

Additional DoD documentation requirements include a Form DD250, *Material Inspection and Receiving Report*, for non-commercial items. In limited cases, a certificate of analysis or certificate of equivalency also is required. Labeling requirements for DoD HAZMAT and non-DoD HAZMAT shipments are similar, and they require the following elements:

- Shipping label affixed to the outermost container
- Preprinted, DoT-mandated, diamond-shaped hazard labels affixed to outer and intermediate containers.

We found that, in some cases, specific instructions on label placement for HAZMAT shipments are called out in the contract.

Most survey respondents stated that the time required for preparation of shipping documentation and labeling is typically 30 minutes or less, as shown in Figures 4-1 and 4-2. Several vendors use computer automation to generate shipping documents and labels. The MSDS typically is in hardcopy and photocopied as needed. It is common for HAZMAT vendor contracts to require vendors to provide the MSDS only to the contracting office or only on the first shipment or only on the first box of a multi-box shipment. With these contractual terms in place, products and their associated critical product data easily can become separated along the supply chain.

Figure 4-1. Shipping Documentation Preparation Time

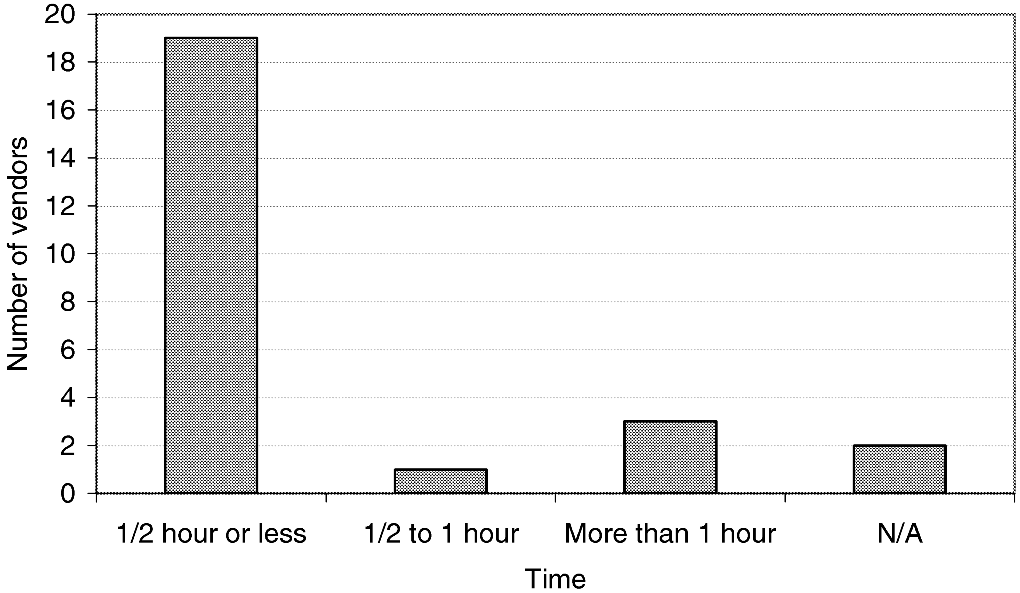
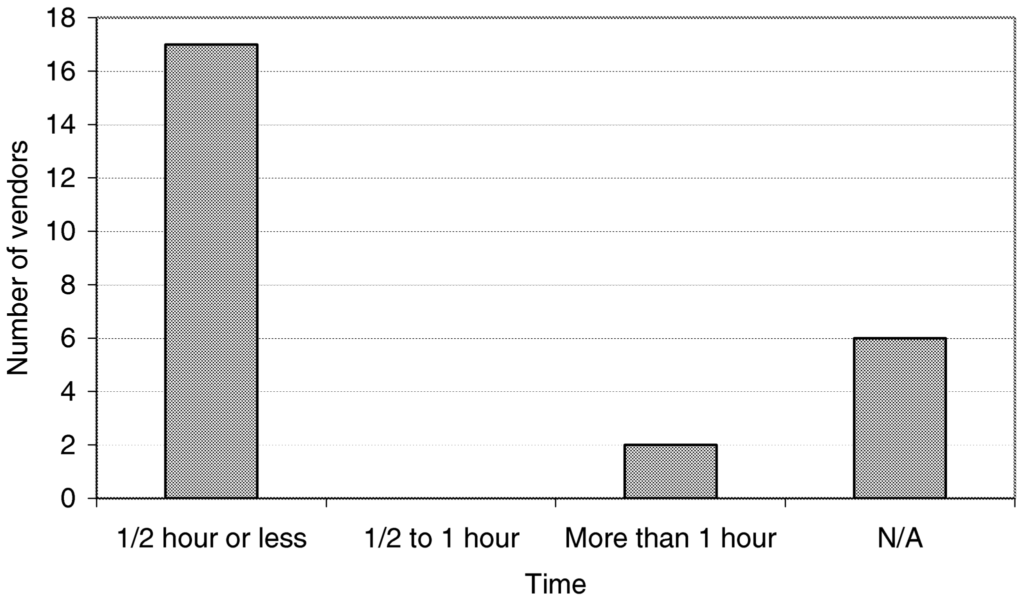


Figure 4-2. Labeling Preparation Time

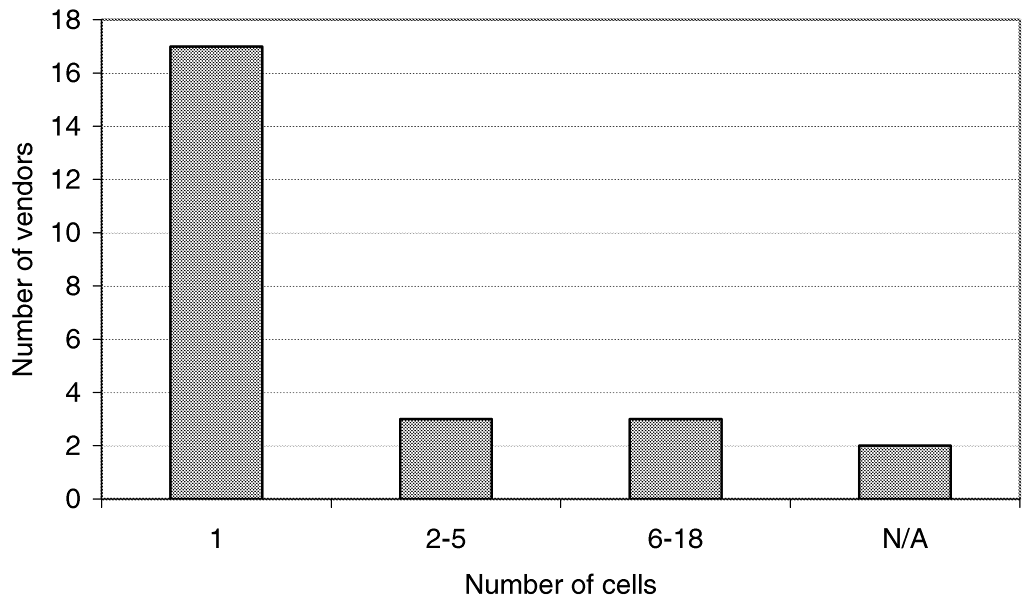


We received no complaints from vendors concerning the shipping documentation and labeling requirements and process for HAZMAT shipments to DoD. A few vendors did complain of having difficulty finding available government-specified carriers to move shipments from the vendor to the depots, and the qualifications of Quality Assurance Representatives.

PACKING AND LABELING CELLS

An important element in estimating the cost of equipping HAZMAT vendors with the RFID technology to tag shipments is the number of packaging or labeling cells a typical HAZMAT vendor has. Figure 4-3 illustrates the number of packing cells vendors in our survey reported. Most vendors have a single packing and labeling cell or a single location within their facility where shipping documentation and labels are prepared and affixed.

Figure 4-3. Number of Packing and Labeling Cells



BUSINESS CONSIDERATIONS

Figures 4-4 and 4-5 illustrate the amount of HAZMAT business and DoD business that surveyed vendors reported. Although sales of hazardous materials represent a significant portion of business for most vendors surveyed, sales of hazardous materials to DoD represent a small portion of overall sales. For half the vendors surveyed, DoD HAZMAT accounts for less than 20 percent of their sales. One vendor would be unwilling to support any DoD requirement that is not integrated with DoT, Customs, and State Department processes and requirements.

Figure 4-4. HAZMAT Sales as Percentage of Total Business

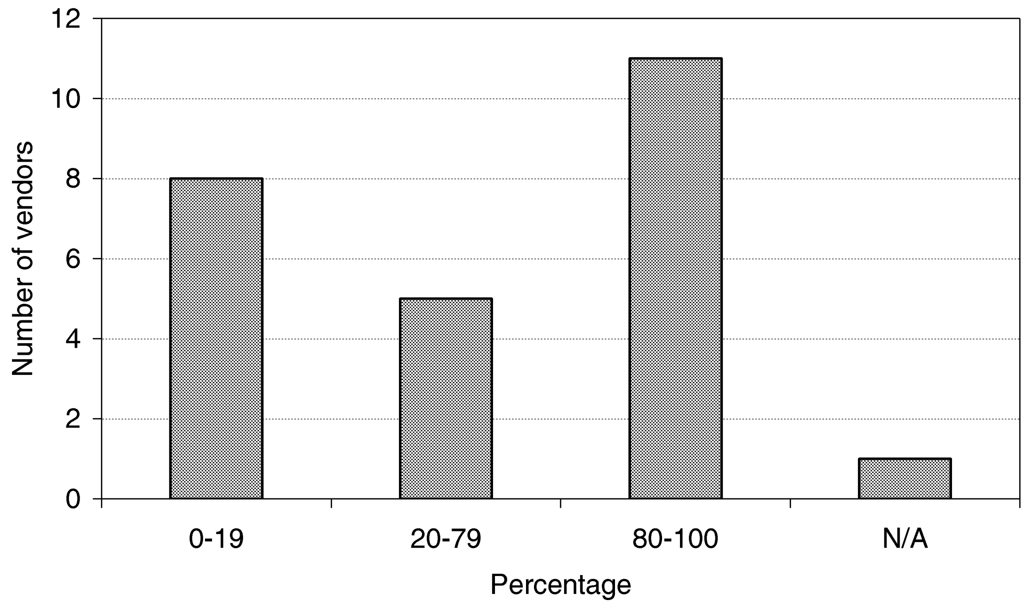
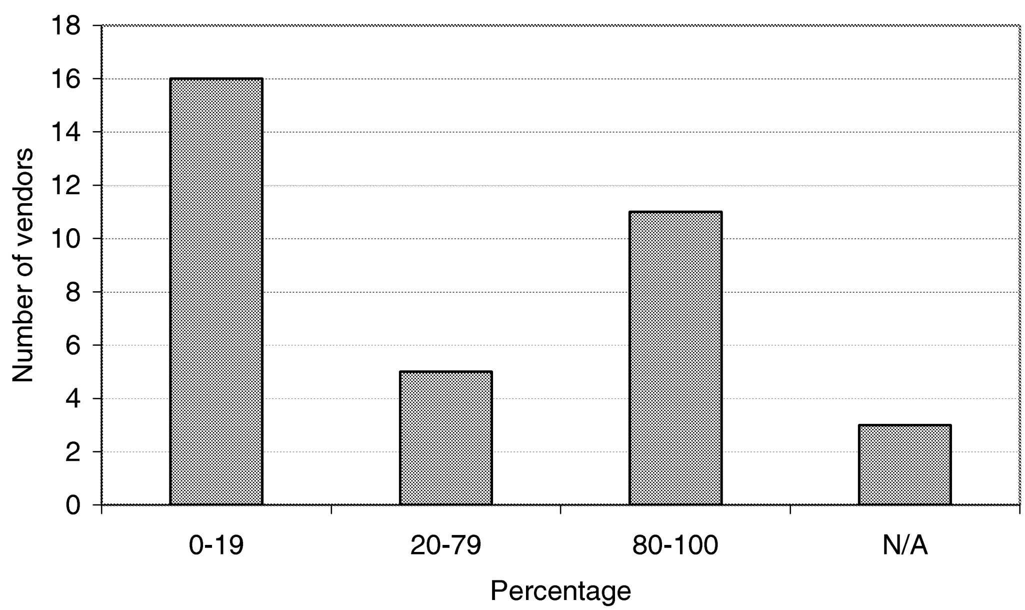


Figure 4-5. DoD HAZMAT Sales as Percentage of Total Business



Depots

DLA depots handle the wholesale functions of the DLA HAZMAT supply chain. Using the storage mission code as the HAZMAT identifying discriminator for DLA-managed items, DORRA data from fiscal year 2000 (FY00) identified 25 depots that received potentially hazardous material. The results indicate that in FY00, DLA depots processed approximately 7,900 procurement receipts and 11,100 field-return receipts. (Base Realignment and Closure [BRAC] activities since FY00 have caused the number of depots to drop to less than the 25 identified by the FY00 data.)

The results for the New Cumberland depot from the Management Information System (MIS) receipts file appeared significantly lower than reported by the depot itself. In this case, we used the statistics from the depot instead of the MIS receipts file data.

The data also show that of the 25 CONUS depots, 6 (Tracy, Richmond, New Cumberland, Hill, Oklahoma City, and Warner Robbins) receive more than 80 percent of all depot HAZMAT receipts. Table 4-2 lists the depots and gives a breakdown comparing procurement receipts with field returns.

Table 4-2. Depots HAZMAT Receipts

Depots	Procurement receipts	Field returns	Total receipts
Richmond	2,347	2,884	5,231
New Cumberland[a]	542	1,839	2,381
Hill	1,125	1,026	2,151
Tracy	1,221	903	2,124
Oklahoma City	1,285	775	2,060
Warner Robbins	897	668	1,565
San Diego	45	799	844
Corpus Christi	48	618	666
Norfolk	24	514	538
San Antonio	228	151	379
Pearl	5	280	285
Puget Sound	51	227	278
McClellan	20	92	112
Sharpe	45	55	100
Anniston	—	90	90
Jacksonville	9	37	46
Ship non-Nuc[lear]	3	38	41
Albany	2	34	36
Red River	2	27	29
Tobyhanna	1	16	17
Columbus	—	15	15
Cherry Point	—	13	13
Barstow	—	4	4
Kaneohe Bay	—	2	2
Ship Nuc[lear]	—	2	2

[a] Defense Distribution Center provided New Cumberland data.

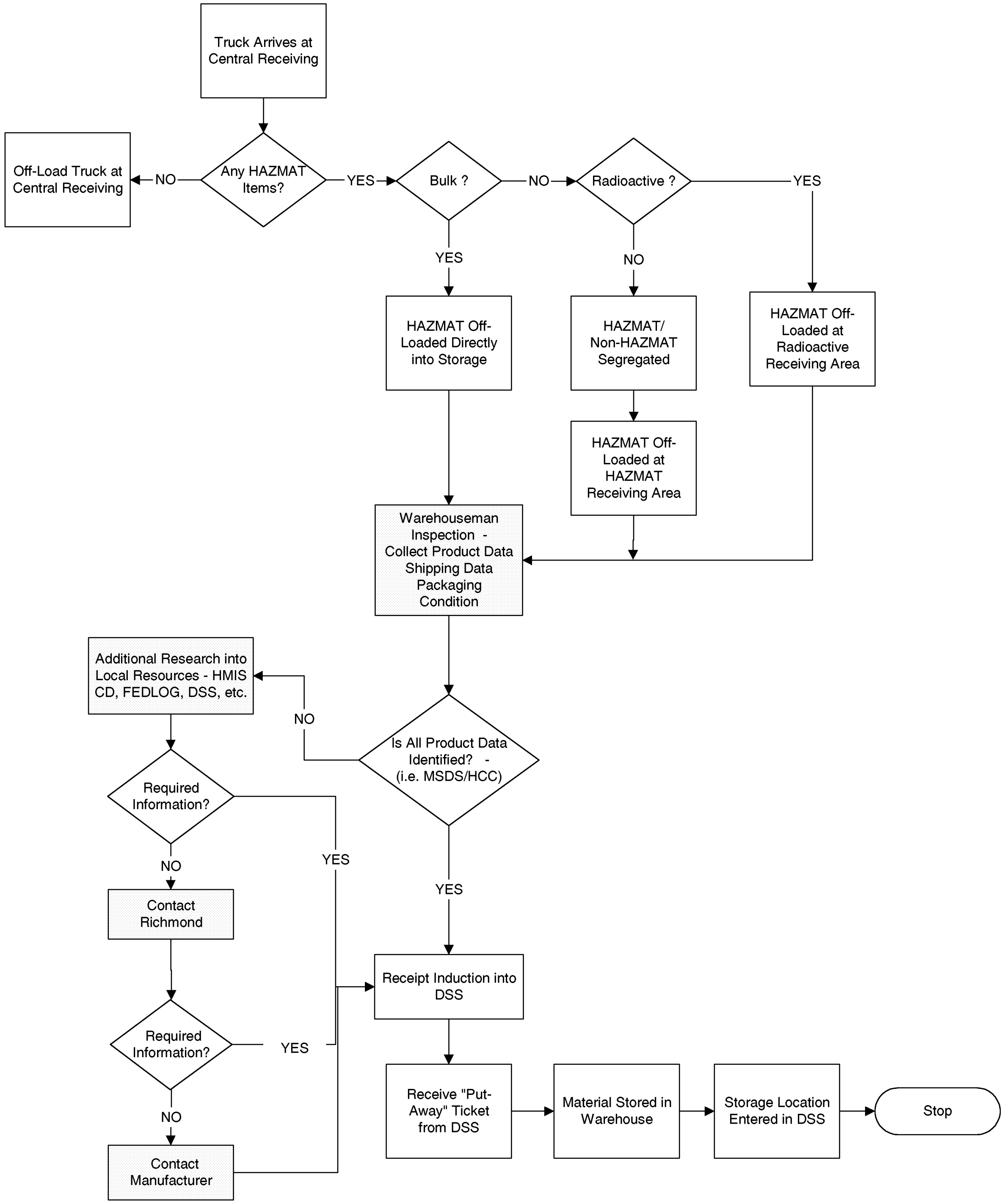
We contacted three of the six leading depots—Tracy, Richmond, and New Cumberland—to discuss their receipt, storage, and shipping processes. Generally, each depot handles HAZMAT the same way. Most differences in the operational flow are caused by the physical layout of the HAZMAT facilities at each depot. There is also a notable difference among the depots in the use of available technology such as bar code scanners, even though all the depots were equipped for their use. From data gathered on the site visits, we developed a composite that characterizes the generic, primary operational flow associated with depot HAZMAT handling as shown in Figure 4-6.

ARRIVAL AT DEPOT CENTRAL RECEIVING

Trucks typically arrive at a central receiving warehouse. Warehouse workers at central receiving review the associated shipping documentation, transport warning placards, and container warning labels, and identify HAZMAT shipments. The warehouse workers exercise extreme caution and forward any items viewed as potentially hazardous, regardless of documentation or marking, to the HAZMAT receiving area.

HAZMAT full truckload shipments are sent directly to HAZMAT warehouse storage locations, bypassing the HAZMAT receiving areas. If a truck contains a mixed load, the items are segregated at (a) the central receiving warehouse with the HAZMAT items shuttled to the HAZMAT warehouse for induction, or (b) the HAZMAT warehouse with the non-HAZMAT items shuttled back to central receiving. Radioactive items are off-loaded at the designated radioactive receiving area.

Figure 4-6. HAZMAT Induction Process at DLA Depots



ARRIVAL AT HAZMAT RECEIVING

Most shipments that arrive at the HAZMAT receiving area are less than full truckload shipments. After off-loading of the HAZMAT, the warehouse workers verify the material with information contained in the shipping documentation—typically a Department of Defense Form 250 (DD250) or DD1348, *Material Issue Release/Receipt Document*—and the Distribution Standard System (DSS). The following information is gathered from the documentation and verified as appropriate:

- National stock number
- Quantity
- Condition
- Contract number
- Manufacturer
- Stock number
- Lot number
- Manufacturing date
- Container type
- Number of containers
- Container weight
- Receipt control number
- Proper labeling and packaging.

Because workers take caution handling potentially hazardous material, they mistakenly forward non-HAZMAT from central receiving to the HAZMAT receiving area approximately 10 times a week, which takes about 10–15 minutes of a warehouse worker's time to research and conclude that the material is not hazardous.

MATERIAL INDUCTION

Information gathered from the shipping documentation and verification process provides a starting point for the induction data required by the DSS. Figure 4-7 shows a view of the DSS induction screen.

The required data fields for proper induction vary with the nature of the item received; however, key data elements are always required for induction of HAZMAT shipments, regardless of the item.

Figure 4-7. DSS Induction Screen

```
RI70        SITE: HWJ2     DISTRIBUTION STANDARD SYSTEM     WK: J2       PAGE 001
09:58:45                    RECEIPT STORAGE INDUCTION                    08FEB2001

CONVEYANCE ID:               OCN/PUTAWAY:                   EMPL ID NO: TJC6633
RCN:                         STK NO:                        U/I:
PIIN:                        CALL:                          CLIN:
DOC NO:                      SUPPL ADR:                     STK ITM CD:
WEIGHT REC:         .        HEIGHT:                        NOUN:
OWNER ROUTE ID:              EXPIRATION DATE:               CONDITION CD:
                                                            MSDS :
                                                            HCC  :
QTY CONVEY:                  SL CD:                         PPP&M:
CIIC:                        SCIC:                          LOC ACT CD:
LOT NO:
TYPE STORAGE CD:             WORK SITE:                     NEW LOCATION:
OVERRIDE CD (1/2/3):         OVER WEIGHT:

PUTAWAY:                     WAREHOUSE MANDATORY:           QBL CBE:
NUMBER OF LABELS:            LOCATION:                      QBL WT :

-----F1=MENU--------F2=NEXT TRANS--------F3=EXIT DSS--------F5=BOOKMARK--------

TRANS CONTINUES                                                NEXT TRANS==>
```

Following is a list of the key data elements for all HAZMAT:

- Contract, control, or document number
- MSDS serial number
- Hazardous characteristics code
- Lot number
- Manufacturing date
- Manufacturer/Commercial and Government Entity (CAGE) code
- Quantity
- Condition
- Expiration date, if applicable.

Some data elements are taken directly from information contained on the MSDS or derived from it. By using data from the MSDS, the warehouse worker also determines the hazardous characteristics code (HCC) assigned by DLA. For DLA-managed items, vendors provide a MSDS to the contracting officer, who forwards it to Defense Supply Center, Richmond (DSCR). After a detailed review, an

HCC is assigned and the MSDS and any additional material information not included in the MSDS is loaded into the Hazardous Material Information System (HMIS) system. Typically, a delay is associated with adding a MSDS to the HMIS system because there is a large backlog at DSCR.

Ideally, a copy of the MSDS is included in the shipping documentation. Unfortunately, many times shipments arrive without an MSDS. These MSDSs may be missing for of a number of reasons. Following is a list of the most common reasons the MSDS is missing:

- Never attached to the shipment by the vendor.
- Sent separately from the shipment, for example, with the invoice.
- Attached to a different pallet on a multi-pallet shipment.
- Became detached during transport.
- Detached at central receiving.

Two depots report that more than 95 percent of HAZMAT shipments received require additional research because a MSDS is missing or the MSDS furnished does not provide complete data. Warehouse workers have few resources to gather the required information. Some of the resources are the local DSS, HMIS (either on CD or through the Internet), and FedLog. Estimated research time averages an hour to gather the required missing data.

About 10 times a week, warehouse workers are unsuccessful in gathering the required information from the available resources. When this happens, the warehouse worker contacts an inspector or expediter to conduct further research. Typically, the first non-local resource an inspector uses is a call to DSCR.[2] If the call to DSCR does not produce sufficient results, the inspector calls the manufacturer directly. Calls to the manufacturer resolve most information needs within a couple of hours, but it has taken up to 2 weeks in extreme cases. The actual time an inspector spends researching can range conservatively from 1 to 2 hours to an extreme of 1 to 2 days. For our study, we used 2 hours for typical inspector research time.

After sufficient product information is gathered for induction, the information is entered into DSS. DSS then generates a put-away ticket that provides a suggested location for storage of the material. The warehouse worker determines the actual storage location, and the actual location is entered in DSS. Induction information and actual storage location for bulk shipments that are offloaded directly into a permanent storage location are input in DSS when the off-loading is complete.

[2] Defense Supply Center, Richmond, is home to the DLA Hazardous Material Information System and Hazardous Technical Information Services.

Although receipts of HAZMAT without an HCC or MSDS serial number cannot be processed by DSS, the lack of information may not delay the material from being stored or issued. One depot indicated that if a warehouse worker is unsuccessful in his or her research in a reasonable amount of time, information from a like item is used to induct the material. In this case, the warehouse worker searches the local DSS for like items and substitutes the like item information for the missing information. The HCC code used is “P” for pending, and the material is stored as having the characteristics of the most hazardous like item in storage. The on-going research does not delay the storage, retrieval, or shipment of material. Processing time would be reduced if these two key data items—MSDS and HCC—were available immediately. Processing time could be reduced if the MSDS format were standardized and always complete.

STORAGE

The put-away ticket DSS generates suggests an initial storage location for the material. Typically, the actual storage location is different, and the DSS must be updated with the actual storage location after the material is put away.

A snapshot of the FY00 4th quarter DORRA item and header file indicates that the amount of HAZMAT items on-hand in DLA depot inventory was approximately $114 million. Wholesale demand data for FY00 indicates a daily wholesale demand dollar value of $495,000. This results in approximately 230 days of supply of these potentially hazardous items stored in DLA depots.

SHIPPING

The depot receives material release orders (MROs), DSS generates a DD1348 for the items to be shipped, then the items are pulled from storage and sent to the packing area for shipment preparation. Certified personnel pack items according to the requirements for the mode of shipment. An MSDS is not required for shipment unless it is designated as a Foreign Military Sale item. Typically, a DD1348 is the only shipping document associated with the shipment.

Approximately 310,000 HAZMAT MROs were issued for all CONUS depots in FY00, based on data in the DORRA MIS issues files. The data do not include CCP MROs.

We estimate that approximately 4 percent of materials ordered from DLA hardware centers are by direct vendor delivery (DVD). By applying this figure to the number of HAZMAT depot issues—310,000 per year—we estimate that approximately 12,900 of HAZMAT orders to customers are fulfilled using DVD.[3]

[3] Data taken from *DLA Logistics Metrics Analysis Reporting System-Requisition Pipeline Activity by Corp Fill Reports for FY00*, https://daynt8.daas.dla.mil/lmars/main.asp.

Containerization and Consolidation Points

The CCPs are responsible for consolidating shipments for outside the continental United States (OCONUS) users. The CCP receiving operations are similar to the depot operations above, except that their receipts are not inducted into depot inventory. Material intended for OCONUS users sent through the CCPs are identified and treated as transshipment items. Although the CCP material is not inducted into inventory, a valid or pending MSDS and HCC are required before the material is sent to its intended user.

We interviewed personnel at both the Tracy and New Cumberland CCPs. Each location receives approximately 11,500 HAZMAT shipments a year, or approximately 900–1,000 a month at New Cumberland, 960 a month at Tracy. Because almost all of their shipments are sent OCONUS, considerations for the packing and shipping operations are not included in this analysis because they are outside the CONUS scope of this BCA.

The New Cumberland CCP reports that 10 percent of its HAZMAT shipments arrive without an MSDS. Tracy reports a similar frequency observed by their HAZMAT warehouse—about 95 percent. The steps to remedy the occurrence of missing MSDS information, which also involves research by warehouse workers, follow the same methods as those described for depots.

Service/Customer Installations

CUSTOMER DATA COLLECTION DESCRIPTION

We conducted a telephone survey from mid-February 2001 to mid-March 2001 of Department of Defense customers receiving, storing, and shipping hazardous material. Customer respondents consisted of HAZMAT warehouse supervisors, shipping and receiving supervisors, and HAZMAT branch and division managers.

Our survey targeted 49 large DoD HAZMAT service installations based on the volume of shipments they receive. These installations were identified in the DLA FY00 DORRA MIS issues file as having a high number of depot-issued HAZMAT items. Twenty-nine of the installations did not respond. Twelve installations responded, but did not provide the requested data for the following reasons:

- Three referred the request to their higher headquarters for approval to respond; no response was provided after the request was made.
- Two requested A-76 non-disclosure statements before providing data; we provided the statements, but the installations still did not respond.
- Two were unwilling to participate in the survey because of A-76 concerns.

- Two provided references to the DLA contractor now providing this support.
- Two indicated that the base is scheduled for closure.
- One indicated that the person able to respond was unavailable for questioning.

Table 4-3 lists the eight survey respondents.

Table 4-3. Respondents to Customer Installations Survey

Base/Installation	Location
Eglin Air Force Base	Florida
Kirtland Air Force Base	New Mexico
Luke Air Force Base	Arizona
Fleet Industrial Supply Center (FISC)	Virginia
Fleet Industrial Supply Center (FISC)	California
Fort Bragg Public Works Business Center	North Carolina
Fort Hood Directorate of Public Works Pharmacy	Texas
Fort Rucker	Alabama

Our interviews centered on the customers' identification, sorting, receipt processing, storage, and shipping procedures. Our purpose was to determine how they identified shipments as HAZMAT, unique procedures for handling HAZMAT, additional processing time required, informational needs and voids, added processing time caused by these voids, and other recurring problems faced in the receipt processing of HAZMAT.

CUSTOMER INSTALLATION OPERATIONS

Receipt Processing

The average volume of HAZMAT received by the eight surveyed sites ranged from 0.5 to 10 shipments per day and averaged eight shipments per day across all sites. Table 4-4 shows the average daily volume by site.

All of the surveyed sites received hazard Classes 2 through 6 and Classes 8 and 9; two of the eight sites also received Class 7 (Radioactive Materials), while none of the sites handled Class 1 (Explosives and Ammunition).

Table 4-4. Average Daily HAZMAT Receipts by Site

Base/Installation	Daily average number of HAZMAT receipts
Eglin Air Force Base	8.0
Kirtland Air Force Base	95 total–mix of HAZMAT and Non-HAZMAT
Luke Air Force Base	7.5
FISC, Norfolk	Not Known
FISC, San Diego	10.0
Fort Bragg Public Works Business Center	9.0
Fort Hood Directorate of Public Works	6.0
Fort Rucker	0.5

The source of most shipments received by the sites surveyed is from vendors, followed by depots and then unit returns (two sites). Table 4-5 shows the source of receipts for each site.

Table 4-5. Sources of HAZMAT Receipts

Base/Installation	Percentage			
	DVD	Depot	Units	Other
Eglin Air Force Base	—	80	—	20
Kirtland Air Force Base	70	30	—	—
Luke Air Force Base	50	50	—	—
FISC, Norfolk	60	40	—	—
FISC, San Diego	30	30	35	5
Fort Bragg Public Works Business Center	—	60	40	—
Fort Hood Directorate of Public Works	100	—	—	—

HAZMAT Identification

Seventy-one percent of customers use shipping documents to identify shipments as hazardous materials, 57 percent of customers use labels, and 43 percent use external markings on the shipment to identify HAZMAT.

Shipment Documentation

Customers typically use the shipment documentation for information needed to process the shipment receipt. The primary shipment documentation used for shipment receipt processing are DD1348, DD250, Purchase Order/Vendor Documentation, and MSDS. Our survey respondents were asked to estimate how many HAZMAT receipts come with each type of documentation. Table 4-6 shows the results for each respondent.

Table 4-6. Receipt Shipment Documentation Frequency by Site

Base/Installation	Percentage				
	DD1348[a]	DD250	PO/ Vendor	MSDS	No document
Eglin Air Force Base	63	37	—	—	—
Kirtland Air Force Base	88	12	—	—	—
Luke Air Force Base	75	25	—	75	—
FISC, Norfolk	12	—	88	—	—
FISC, San Diego	25	—	15	35	60[a]
Fort Bragg Public Works Business Center	100	—	—	—	—
Fort Hood Directorate of Public Works	—	—	100	100	—
Fort Rucker	100	—	—	100	—

Note: PO = purchase order.
[a] Defense Distribution Depot, San Diego, CA replaces DD1348 with DSS manifest documentation.

HAZMAT Receipt Processing Time

There are two types of facilities among the customers surveyed. Most are supply warehouses that process, store, and issue quantities as "unit of issue" (for example, a case of spray paint). The remainder are retail stores called "pharmacies" that issue individual items (for example, cans of spray paint) to end users. The difference is reflected in the time it takes each type of facility to process arriving shipments. When all needed documentation and information are available, the average receiving process is 15 to 20 minutes a shipment into the warehouse. Retail stores then open the boxes, prepare, print, and attach a unique bar code label to each individual item and place the individual items on the shelves. For example, a shipment of spray paint cans with a piece count of 500 would require preparation, printing, and affixing 500 unique bar code labels plus stocking the shelves with the individual cans. Depending on volume, whether the item is a new item or already in inventory, and staffing levels, the receiving process takes a day or more. Table 4-7 shows the time respondents reported that it takes to process HAZMAT shipments at their bases and installations.

To receive a shipment, surveyed sites need a supply document (DD1348, DD250, or purchase order) and access to a MSDS, either with the shipment or on file. If information is missing from the documentation, induction takes longer. Critical among these documents is the MSDS. Sites reported that missing paperwork required from 15 minutes to several weeks to research and resolve. Table 4-8 shows the additional delay sites reported that voids in HAZMAT paperwork took to research and resolve. These delays refer to the time that a shipment is delayed from being inducted, but not the total time the warehouse worker is required to research the missing paperwork. We estimate that the average amount of actual labor time spent on research caused by missing paperwork is similar to the 2-hour-per-incident average we observed for the depots.

Table 4-7. HAZMAT Receipt Processing Time

Base/Installation	Processing Times
Eglin Air Force Base	30 minutes with no problems
Kirtland Air Force Base	15 minutes
Luke Air Force Base	10–15 minutes[a]
FISC, Norfolk	15–30 minutes or less
FISC, San Diego	2 hours to 1 day[b]
Fort Bragg Public Works Business Center	2 days
Fort Hood Directorate of Public Works	5–10 minutes

[a] Based on volume and staff available.

[b] If paperwork and automated system are available.

To receive a shipment, surveyed sites need a supply document (DD1348, DD250, or purchase order) and access to a MSDS, either with the shipment or on file. If information is missing from the documentation, induction takes longer. Critical among these documents is the MSDS. Sites reported that missing paperwork required from 15 minutes to several weeks to research and resolve. Table 4-8 shows the additional delay sites reported that voids in HAZMAT paperwork took to research and resolve. These delays refer to the time that a shipment is delayed from being inducted, but not the total time the warehouse worker is required to research the missing paperwork. We estimate that the average amount of actual labor time spent on research caused by missing paperwork is similar to the 2-hour-per-incident average we observed for the depots.

Table 4-8. Delay Missing Paperwork Causes in Inducting Material

Base/Installation	Additional processing times
Eglin Air Force Base	1 to 5 days to resolve
Kirtland Air Force Base	15 minutes to a couple of days
Luke Air Force Base	1 day to weeks to resolve
FISC, Norfolk	—[a]
FISC, San Diego	1.5–2 hours
Fort Bragg Public Works Business Center	—[a]
Fort Hood Directorate of Public Works	—[b]

[a] Not all surveyed bases/installations provided a response.

[b] MSDS provided and on file with a copy of the purchase order at the time approval is given to order.

Research Sources

Research sources include the HMIS, local history files, websites and other sources. Customer sites can access the HMIS database through the Internet, but most prefer to use the HMIS compact disc that is distributed quarterly.

As seen with material sent to the depot, some delay can occur between the time a vendor ships a product and when the MSDS is available in HMIS. Most respondents said they use alternate sources for MSDS information when it is not available on HMIS. Two respondents maintain local history files of MSDSs obtained from previous shipments, local procurements, sales representatives, and seminars. Two use websites; one uses university websites of MSDSs, and the other uses manufacturers' websites. Other sources include calls to vendors, other shippers, Defense Reutilization and Marketing Offices (DRMO), and DSCR. One uses current inventory as a source of MSDS information. Respondents also use the Federal Logistics Information System to cross-reference a part number with a CAGE code or an item name as a research source. Table 4-9 shows the sources used by each respondent site.

Table 4-9. Customer Research Sources

Base/Installation	HMIS	FedLog	Web-based	Historical files	Other sources
Eglin Air Force Base	✓	—	—	—	—
Kirtland Air Force Base	✓	✓	✓[a]	—	Richmond
Luke Air Force Base	✓	✓	✓[b]	✓	—
FISC, Norfolk	✓	✓	—	—	—
FISC, San Diego	✓	✓	—	✓	—
Fort Bragg Public Works Business Center	✓	—	—	—	Vendors/ DRMO
Fort Hood Directorate of Public Works	—	—	—	—	Stock/Units

[a] Manufacturer website.
[b] University website.

Receiving Problems

Six respondents reported recurring problems with receiving HAZMAT: lack of an MSDS, expired shelf life, wrong item shipped, partial shipments, and problems with packaging and labels. The first three, which occur in approximately 12 percent of receipts, might be resolved if reliable needed information were always available with each item. Table 4-10 shows the recurring receiving problems reported by respondents.

Table 4-10. Receiving Problems

Base/Installation	Recurring Problems	Percent of problems
Eglin Air Force Base	No MSDS or not loaded in HMIS	35
Kirtland Air Force Base	Wrong item received–depot redistribution	5
Luke Air Force Base	Label does not match MSDS Expired/short shelf life	30 2.5
FISC, Norfolk	Expired shelf life Partial shipments from depot Improper packaging and markings from depot	(No frequency given)
FISC, San Diego	DSS manifest lacks proper information Misdirected shipments Problems with commercial packaging	60
Fort Bragg Public Works Business Center	None	0
Fort Hood Directorate of Public Works	Damage Wrong item Partial shipments	2
Fort Rucker	No MSDS	(No frequency given)

Customer Issues

All surveyed sites issue HAZMAT to units. Most often, customer central receiving sites deliver the material to the user or the user picks up the material from the HAZMAT warehouse. Occasionally, this involves the HAZMAT warehouse shipping to units off base, either to units they directly support or to other installations to fill a unit requisition at the request of the depot. Other than units, DRMO is the most frequent destination, followed by returns to depots.

The average number of issues and shipments the surveyed sites make a week is 14. The average additional time to prepare for a HAZMAT shipment is 45 minutes (reported time ranged from 5 minutes to 2 hours). The sites that shipped HAZMAT primarily use less-than-truckload freight carriers and small package express air. One site reported exclusively using small package express ground carriers.

Disposal Activities

DRMO is responsible for the disposal of hazardous waste for the DoD in accordance with DoDI 4715.6, *Environmental Compliance*. There are approximately 80 DRMO centers in operation. DoD regulation, turn in activities, and DRMO regulate the plan, schedule, and hazardous material coordination turn-ins. Information required for turn-in transactions differs from HAZMAT shipping and receipt information. In addition to valid national stock numbers and product name, other documentation required at turn-in activity includes the following information:

- Hazardous waste profile sheet—annually
- Fund site
- Source of funds
- Analysis of Environmental Protection Agency (EPA) regulations.

DRMO operations also may take ownership material that physically remains in the depot storage area. The material is held in depot storage until the DRMO sells the material or the disposal contractor removes the material. When the contractor removes the material, no physical material transfer occurs. Because of normal DRMO turn-in procedures, the potential benefits of MICLOG could be limited.

ALTERNATIVE 2—MICLOG

The second alternative is implementing RFID technology along the CONUS DLA HAZMAT supply chain. We assessed Alternative 2 using Alternative 1 as the baseline in our analysis of cost and process efficiencies.

In the RFID scenario, the DLA HAZMAT vendors would be equipped to affix RFID-enabled tags on each HAZMAT shipment. Before shipping to DLA or a DLA customer, the vendor would upload limited product information to the label, as well as key product and shipment information required for induction to a central data repository. This central repository would store all relevant product and shipment information in a relational database, thus linking the data to the shipment's RFID tag.

Depot and service customer HAZMAT receiving areas would be equipped with portals at HAZMAT receiving doors. As a HAZMAT shipment arrives at the receiving area and enters the warehouse, the RFID tags affixed to the HAZMAT shipment would be interrogated immediately as the shipment passes through the RFID portal. The data received from the interrogation would be used to query the central repository database and extract relevant product and shipment information that was uploaded by the vendor. The complete and accurate MSDS-related information required for induction would be available immediately. This would reduce or virtually eliminate the need for additional research by the depot or service customer personnel.

Chapter 5
Analysis Findings

ASSUMPTIONS

In this analysis, we made several assumptions of equipment and installation costs. Table 5-1 shows the estimated costs of equipment needed to enable a facility write to RFID shipping tags and to read incoming shipment RFID tags.

Table 5-1. Estimated Equipment Costs

Equipment	Estimated costs
Printer	$5,000
PC server	3,000
PC wireless card	250
Portal	
915 MHz reader	2,400
915 MHz antennae—$225×2	450
Wireless interface/access point	500
Framework—hardware	400
Total	$12,000

Note: MHz = megahertz.

We anticipate that a two-person team consisting of a technician and a software engineer will be sufficient for each equipment installation. The estimated labor rate is $500 per day per person or $1,000 per day for the team. We also anticipate that the team can install the equipment at a rate of two portals a day.

We made general assumptions about travel costs to estimate the total costs to transport personnel required to install the equipment at each location. The estimated airfare is an average $750 per person per location. We estimated the per diem allowance, including lodging and meals, to average $125 per day per person. We estimated car rental costs to average $50 per day per installation team. We also assume that the installation team will require 1 day for travel in addition to the number of days required for equipment installation. Table 5-2 summarizes these costs.

Table 5-2. Estimated Labor-Related Installation Costs

Cost parameter	Estimated cost
Labor costs (technician, software engineer)	$500 per day per person
General airfare	$750 per site per person
Per diem allowance	$125 per day per person
Rental car cost	$50 per day
Portals installed per day	2 per day per site
Personnel per installation	1 technician, 1 software engineer

The equipment and installation likely will be procured through a subcontractor. We estimate a burden of 15 percent over the estimated costs in Table 5-2 to account for general and administrative (G&A) costs.

ESTIMATED SYSTEMWIDE COSTS

To support the MICLOG concept, supply chain activities must be capable of uploading and downloading specific product and shipping data. This includes the manufacturer, wholesale, and retail activities that produce, use, and distribute HAZMAT. To ensure like data and reliable data exchange, it will be necessary either to link existing database systems or develop a data repository that can store and retrieve desired data. To estimate the cost to develop a data exchange capability, we identified two data systems that provide similar functions.

The DLA Apparel Research Network has a supply chain management system with similar characteristics including a relational database structure, controlled web-based access, data and documents electronically transferred between vendors, wholesale and retail operations, and interfaces with legacy systems. Development of this system required 4 years with annual costs ranging from $1 million to $1.5 million. The other example system is the next-generation HMIS system that is under development. This system will handle XML-formatted MSDSs. LMI has estimated that the cost to develop this system would be about $5 million. Based on the costs of developing these two systems, both around $5 million each, we anticipate a similar cost to develop the MICLOG data repository. For this analysis, we use the estimated cost of $5 million spread over 4 years to develop a like-system for MICLOG. We estimate annual maintenance costs at $125,000 after the system is implemented.

ESTIMATED VENDOR COSTS

Most vendors we surveyed said the tasks of gathering and preparing documentation place minimal burden on vendor operations; therefore, we assume vendors will see the RFID tag technology implementation as affecting current vendor HAZMAT labeling operations in two ways:

- Equipment and set up costs
- Additional cost of RFID labels over the current standard shipping label.

In the following sections we discuss various effects MICLOG implementation could have on vendors.

Vendor Equipment and Set-Up Costs

Our vendor survey indicated that a typical HAZMAT vendor has one packaging cell, which will need to be equipped for RFID tagging of shipments. For our assessment, we assume that equipping each of the estimated 840 vendors with one set of equipment (personal computer [PC] server, printer, and portal, plus installation) will provide the capability to affix RFID tags on shipments. Following are the estimated costs to vendors to equip for MICLOG operations, and an estimated total cost to equip 840 vendors:

Equipment costs—PC server, printer, portal		$12,000
Installation, travel and labor costs (2 days) total		4,100
Airfare	$1,500	
Car rental	100	
Per diem	500	
Labor	2,000	
Total equipment and set-up per installation ($12,000 + $ 4,100 = $16,100 × 1.15 [for contractor G&A])		$18,515
Total to equip 840 vendors ($18,515 x 840)		$15,552,600

Vendor Operational Costs

An operational cost to vendors is the increase associated with using the RFID label over the cost of the current standard shipping label. Opinion within the RFID industrial sector is that a cost of 50 cents per RFID label is achievable with current technology at little risk, and strong evidence indicates the cost of RFID labels will be as low as a few cents per tag.[1] For this analysis, we use the conservative estimate of a 50-cent additional cost per label.

[1] Kevin Maney, "Alien's Tiny Cheap Chips Could Open New Worlds," *USA Today,* March 14, 2001

Following is the estimated operational costs for vendors:

Estimated annual vendor operational costs	
(7,900 procurement shipments direct to DLA per year + 12,900 vendor DVD shipments) x 50 cents cost per shipment	$10,400

ESTIMATED DEPOT COSTS

Depot Equipment and Set-Up Costs

Depot equipment costs will depend on aspects such as the number of HAZMAT receiving areas, the number of HAZMAT warehouses and associated warehouse bays, the number of HAZMAT packaging cells, and shipping volume.

To estimate the cost associated with equipping CONUS depots with RFID capability, we visited and collected data on three (Richmond, Tracy, Susquehanna) of the current 22 CONUS depots[2] that handle HAZMAT. We also received information about layout on a fourth depot (Hill). Because the remaining 18 depots have a significantly lower volume of HAZMAT material than these top four depots, we assume that equipping each of them with two portal set-ups (one for receiving, one for shipping) and a PC server and printer will provide sufficient capability to meet their volume. Table 5-3 summarizes the estimated number of portal set-ups required at each depot.

Table 5-3. Estimated Depot Equipment Required

Depot	PC servers	Printers	Portal set-ups
Richmond	8	4	31
New Cumberland	4	2	14
Tracy	2	2	10
Hill	2	2	4
Other 18 depots	1	1	2

We can estimate the costs for equipment and installation using these numbers.

RICHMOND

Richmond has four separate shipping cells; each will need to be equipped with a PC server and printer. Four additional PC servers may be required for induction transactions. To capture all possible incoming HAZMAT into HAZMAT warehouses, 31 portals will be required.

[2] Base Realignment and Closure activities are causing a decline in the number of CONUS depots.

Following is the total equipment cost estimate:

Estimated equipment costs at Richmond	
8 PC servers plus cards @ $3,250 each + 4 printers @ $5,000 each	$46,000
31 portals @ $3,765 each	116,715
Total Richmond equipment costs	$162,715

The 31 portals at Richmond will require at least 16 days to install, plus one travel day for the installation team. Following is a breakdown of the Richmond travel and labor costs:

Estimated installation costs at Richmond	
Labor: $1,000 per day × 17 days	$17,000
Per diem: $125 per day × 2 people × 17 days	4,250
Airfare: $750 × 2 fares	1,500
Rental car: $50 per day × 17 days	850
Total installation costs	$23,600
Total Richmond equipment and installation costs: $162,715 + $23,600	$186,315

NEW CUMBERLAND

The New Cumberland depot requires at least 14 portals to capture all possible incoming HAZMAT into its HAZMAT warehouses. In addition, we assume New Cumberland will need two PC servers and two printers for shipments and an additional two each for material induction. Following is a breakdown for New Cumberland equipment costs:

Estimated equipment costs at New Cumberland	
4 PC servers plus card @ $3,250 each + 2 printers @ $5,000 each	$23,000
14 portals @ $3,765 each	52,710
Total New Cumberland depot equipment costs	$75,710

The 14 portals will require at least 7 days to install, plus 1 travel day for the installation team. Following is an estimate of installation costs:

Estimated installation costs for New Cumberland	
Labor: 8 days @ $1,000 per day	$8,000
Airfare: 2 @ $750 each	1,500
Per diem: 2 @ $125 per day × 8 days	2,000
Rental car: $50 per day × 8 days	400
Total New Cumberland installation costs	$11,900
Total New Cumberland equipment and installation costs: $75,710 + $11,900	$87,610

TRACY

The Tracy depot requires at least 10 portals to capture all possible incoming HAZMAT into its HAZMAT warehouses, plus two PC servers and two printers (one for general HAZMAT shipping cell, one for radioactive shipping area). Following are the Tracy estimated equipment costs:

Estimated Tracy depot equipment costs

2 PC Servers (plus card) @ $3,250/each + 2 Printers @ $5,000 each	$16,500
10 portals @ $3,765 each	37,650
Total Tracy equipment costs	$54,150

The 10 portals will require at least 5 days of installation, plus one travel day for the installation team. Following are the estimated installation costs:

Estimated Tracy installation costs

Labor: 6 days @ $1,000 per day	$6,000
Airfare: 2 @ $750 each	1,500
Per diem: 2 @ $125 per day × 6 days	1,500
Rental car: $50 per day × 6 days	300
Total Tracy installation costs	$9,300
Total equipment and installation costs for Tracy: $54,150 + $9,300	$63,450

HILL

Hill has two shipping cells for HAZMAT. Each must be equipped with a server and printer. Because of the number of shipping cells and the amount of HAZMAT volume, we assume that Hill requires at least four portals to capture all possible incoming HAZMAT into HAZMAT warehouses. Following are the equipment costs for the Hill depot:

Estimated equipment costs for Hill depot

2 PC servers plus card @ $3,250 each + 2 printers @ $5,000 each	$16,500
4 portals @ $3,765 each	15,060
Total equipment costs for Hill	$31,560

The four portals will require at least 2 days to install, plus 1 travel day for the installation team. Following are estimated installation costs for the Hill depot:

Estimated installation costs for Hill	
Labor: 3 days @ $1,000 per day	$3,000
Airfare: 2 @ $750 each	1,500
Per diem: 2 @ $125 per day × 3 days	750
Rental car: $50 per day × 3 days	150
Total Hill installation costs	$5,400
Total equipment and installation costs for Hill: $31,560 + $5,400	$36,960

OTHER DEPOTS

We assume the other depots will be able to handle HAZMAT receipt and shipping with one PC server and printer set-up and two portals. Following are the estimated equipment costs for each of the remaining 18 depots:

Estimated equipment costs at each remaining depot	
1 PC server plus card @ $3,250 + 1 printer @ $5000 each	$8,250
2 portals @ $3,765 each	7,530
Total equipment costs at each remaining depot	$15,780

The two portals will require at least 1 day to install, plus 1 travel day for the installation team. Following are estimated installation costs for each of the remaining depots:

Estimated installation costs for each remaining depot	
Labor: 2 days @ $1,000 per day	$2,000
Airfare: 2 @ $750 each	1,500
Per diem: 2 @ $125 per day × 2 days	500
Rental car: $50 per day × 2 days	100
Total installation costs	$4,100
Total equipment and installation costs for each remaining depot: $15,780 + $4,100	$19,880
Total cost to equip all remaining 18 depots: 18 × $19,880	$357,840

Table 5-4 summarizes the total estimated costs to equip the 22 CONUS depots.

Table 5-4. Summary of Estimated Depot Equipment and Installation Costs

Depot	Costs
Richmond	$186,315
New Cumberland	87,610
Tracy	63,450
Hill	36,960
Remaining 18 others	357,840
Total	$732,175
Total with 15% G&A	$842,000

Additional installation costs may be required to achieve total connectivity between operations in the depot, a central data repository, and the asset visibility information system. Until detailed site surveys determine the specific connectivity requirements for each depot, it is impractical to estimate those costs.

Depot Operational Costs

As with the vendor operations, there will be one operational cost effect, which is the cost impact of the RFID tag for depot outgoing shipments. We assume the same 50-cent impact per shipment as we did for the vendor cost analysis. Following is the estimate for the specific cost impact:

Estimated additional cost of RFID tag per year	
310,000 depot shipments annually x 50-cent additional cost of RFID tag	$155,000

ESTIMATED CCP COSTS

CCP Equipment and Set-Up Costs

We anticipate the two CCPs will need RFID equipment. Because the scope of this BCA is limited to CONUS shipments, and CCPs ship OCONUS, we analyzed the costs only for the receipt activities at the CCPs. To equip the CCPs to read RFID labels, we estimate each CCP will need two portals and a PC server. Following are the estimated costs to equip each CCP:

Estimated CCP equipment costs	
1 PC server with card @ $3,250 each + 2 portals @ $3,765 each	$10,780
Total to equip 2 CCPs for receiving	$21,650

Following is the estimated cost to install the equipment at the CCPs:

Estimated installation costs at CCPs	
Labor: 2 days @ $1,000 per day	$2,000
Airfare: 2 @ $750 each	1,500
Per diem: 2 @ $125 per day × 2 days	500
Rental car: $50 per day × 2 days	100
Total installation cost per CCP	4,100
Total installation costs for 2 CCPs	$8,200
Total costs to equip the 2 CCPs: $21,650 + $8,200 = $29,850 × 1.15	$34,328

Estimated CCP Operations Costs

Because the scope of this BCA is limited to CONUS shipments, and CCPs ship OCONUS, we analyzed the costs only for the receipt activities at the CCPs.

ESTIMATED CUSTOMER COSTS

Customer Equipment and Set-Up Costs

On the basis of study commissioned by DORRA, the results estimated that 64 CONUS customer installations receive a large volume of DLA HAZMAT. To take advantage of RFID technology benefits, each site will need to be equipped with two portals and a PC server and printer. Following is an estimated equipment cost for each site:

Estimated equipment costs at each customer site	
1 PC server with card @ $3,250 each + 1 printer @ $5,000	$8,250
2 portals @ $3,765 portal	7,530
Total equipment cost for each customer site	$15,780

Following is an estimated cost to install equipment at each customer site:

Estimated installation at each customer site	
Labor: 2 days @ $1,000 per day	$2,000
Airfare: 2 @ $750 each	1,500
Per Diem: 2 @ $125 per day × 2 days	500
Rental Car: $50 per day × 2 days	100
Total installation costs	$4,100
Total cost per customer facility = $15,780 + $4,100	$19,880
With 15% G&A costs added: $19,880 × 1.15%	$22,862
Total cost to equip customer sites: 64 x $22,862	$1,463,168

Customer Operational Costs

The operational cost to the customer consists of the additional cost of the RFID tag over the current costs of shipping labels. Following is an estimated customer operational cost:

Estimated annual customer operational cost	
11,100 field returns x 50-cent cost of tag	$ 5,550

SYSTEM EQUIPMENT MAINTENANCE COSTS

We estimated the annual cost of maintaining equipment to be approximately 5–10 percent of the initial hardware costs. For the vendors, the total equipment costs are approximately $10 million. For the government (depots, CCPs and service installations) the equipment costs are approximately $2 million. For our study, we estimated $850,000 per year for vendor equipment maintenance, and $150,000 per year for government equipment maintenance.

ANTICIPATED BENEFITS

Vendor Benefits

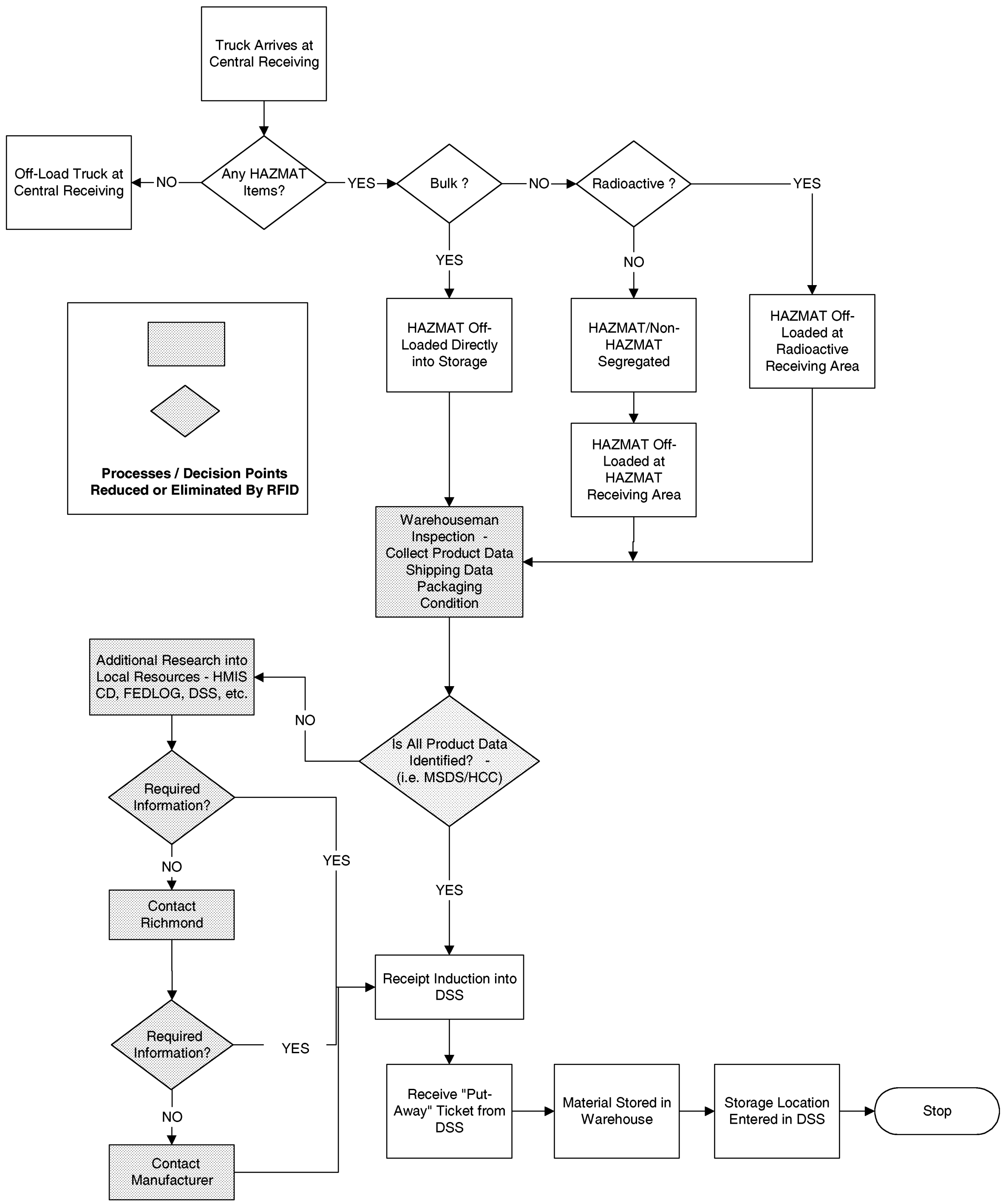
There are no anticipated benefits to the vendor at this time.

Depot Benefits

RFID technology offers the potential to have all product information available immediately on arrival at the depot receiving dock, thus drastically reducing or eliminating the need for research on missing shipping and product data.

For our assessment, we assume that the RFID label will provide data to query a central data repository. This repository, based on a relational database platform, would immediately provide all relevant data needed for induction of the item or material, thus speeding up the induction process and eliminating the need to research missing or incorrect product and shipping data at the receipt point. Eliminating the need for research has the potential for significant efficiencies in the current depot operations. Figure 5-1 indicates processes where reducing or eliminating steps using of RFID technology could produce significant annual cost savings.

Figure 5-1. HAZMAT Induction Process at DLA Depots—Potential RFID Effects



The following section describes our estimates of potential depot cost savings using the RFID technology. We derived these estimates based on our observations, surveys, and other data collected. These potential benefits assume labor is a variable cost. If headcount is reduced, these benefits will accrue as cash flow savings.

If headcount is re-assigned, the benefits will accrue as a productivity gain or cost avoidance.

Our cost-benefit estimates are based on

- automating the induction data input,
- eliminating additional research by warehouse workers, and
- eliminating inspector research time.

AUTOMATING INDUCTION DATA INPUT

By having the shipping source upload all relevant product and shipping information, receiving points can access these data electronically and automatically download the necessary information for material induction activities. We anticipate that this step in the current process, which we conservatively estimate to average 15 minutes per receipt, can be eliminated. To estimate the cost of induction, we used the approximate national average hourly labor rate ($21) for a warehouse worker, WS-06 Step 3. When we add a burden rate of 33 percent (Defense Technical Information Center estimated burden for DLA labor) on a warehouse worker base rate, the result is an overall hourly rate of $28. Following is our calculation of savings:

Estimated annual cost benefit of automating inventory induction data input	
(7,900 procurement receipts + 11,100 field returns × .25 hours × $28	$126,000

ELIMINATING ADDITIONAL RESEARCH BY WAREHOUSE WORKERS

The depots reported that more than 95 percent of receipts require an average of 1 hour for additional research by the warehousemen to collect the proper data for induction. We estimated the annual cost of additional research at the depots by applying this frequency to the annual receipt rate and using the same labor rate for a warehouse worker ($28).

Frequency of receipts requiring additional research	95%
Number of depot receipts (procurement + returns)	18,000 per year
Time required for additional research	1 hour

Following is the estimated annual cost savings by eliminating warehouse worker research time:

Estimated annual cost savings by eliminating depot warehouse worker research	
(.95 x 18,000 per year) x $28 per hour x 1 hour	$478,800

ELIMINATING ADDITIONAL RESEARCH BY INSPECTOR

When research by warehouse workers is unsuccessful (about 20 percent of the time), an inspector must step in. The labor cost for the inspector's additional research is calculated at the national average hourly labor rate of $22 per hour (WS-07 Step 3). Adding the 33 percent estimated burden rate results in an hourly rate of $29.33.

Frequency of inspector research	20%
Time required for inspector research	2 hours
Labor rate for Inspector	$29.33

Following is the estimated annual cost savings by eliminating depot inspector research time:

Estimated annual cost savings at a depot by eliminating inspector research time	
(.20 × 18,000 per year) x $29.33 per hour x 2 hours	$211,176

Following is the total of all the potential estimated cost savings to depots:

Estimated potential annual depot cost savings	
Estimated annual cost savings by automating inventory induction data input at a depot: (7,900 procurement receipts + 11,100 field returns) × .25 hours × $28	$126,000
Estimated annual cost savings by eliminating additional depot warehouse worker research: (.95 x 18,000 per year) x $28 per hour x 1 hour	478,800
Estimated annual cost savings by eliminating depot inspector research time: (.20 × 18,000 per year) x $29.33 per hour x 2 hours	211,176
Estimated total annual depot cost savings benefit	$815,976

CCP BENEFITS

Savings at the two CCPs will result from reducing or eliminating the time spent to research inaccurate or missing product and shipping information. Because CCPs do not induct material into inventory, there are no anticipated savings from the automation of induction activities. However, CCPs must have similar information for transshipments; therefore, additional research is required when information is missing or misplaced. To estimate the current amount of time required for research, we used the information the CCPs provided. The two CCPs (New Cumberland and Tracy) provided dissimilar statistics on the frequency of problems receiving HAZMAT. We were unable to ascertain the reasons for the discrepancy and used the estimates as given. For our estimate, we also used the labor rate for a

WS-06 Step 3 for our estimate. The following calculations estimate potential cost benefits for each:

Estimated potential annual cost savings at New Cumberland CCP	
11,500 receipts ×.1 problem rate × 1 hour × $28 per hour	$32,200

Estimated potential annual cost savings at Tracy CCP	
11,500 receipts × .95 problem rate × 1 hour × $28 per hour	$305,900

Estimated potential annual cost savings at both CCPs	
Estimated potential annual cost savings at New Cumberland CCP	$32,200
Estimated potential annual cost savings at Tracy CCP	$305,900
Total estimated potential cost savings at both CCPs	$337,100

CUSTOMER BENEFITS

Automating the Induction Data Input Process

Annual customer HAZMAT receipts can be estimated using 310,000 depot issues and 12,900 DVD shipments. Having the shipping source upload all relevant product/shipping information, these data can be electronically accessed at the receipt point and automatically downloaded for material induction activities. We anticipate this process, which we conservatively estimate to average 15 minutes per receipt, can be eliminated. We calculated savings using the average warehousemen labor rate:

Estimated potential annual cost savings by automating the customer induction process	
322,900 receipts per year × .25 hours × $28 per hour	$2,260,300

Additional Research by Warehouse Workers

Customer receipt points also potentially benefit by reducing or eliminating additional research. For our estimate, we used information collected in our customer survey. Following is the estimated potential annual cost savings for customers:

Estimated potential annual cost savings by reducing customer research time	
322,900 receipts per year x 12% of shipments requiring research x 2 hour research x $28 per hour labor rate	$2,169,888

INTANGIBLE BENEFIT CONSIDERATIONS

We investigated potential intangible benefits the MICLOG initiative might offer. Cost savings are extremely difficult to assess because it is unclear how the new technology will affect potential cost streams. In the following sections, we describe possible intangible benefits of the MICLOG initiative; however, we did not include them in our financial benefits analysis.

Reducing Transportation Fines

A HAZMAT transportation expert indicated that as many as 30 percent of DLA shipments violate at least one regulation stipulated in Title 49 Code of Federal Regulations because of mislabeling or misinformation. Guidelines for most of the civil penalties associated with breaching these regulations range from $500–$800 for minor violations and $3,000–$6,000 for serious violations.

The DLA HAZMAT supply chain has approximately 342,000 shipments per year (based on FY00 data: 310,000 depot issues, 12,900 DLA DVD shipments, 7,900 DLA procurements, 11,100 DLA return receipts). We calculate the exposure to fines for violations could range from $164.5 million to $1.97 billion.

Reducing EPA Fines

We received a listing of all fines the EPA has levied against government facilities in the past 5 years. From this list, we identified all fines charged against DoD facilities. In that time, 165 DoD facilities were fined approximately $3.35 million for violations. The average fine per violation is a little more than $20,000.

It is unclear how MICLOG technology could help DoD avoid such EPA penalties; therefore, we do not include potential benefits in this analysis.

Table 5-5 provides a breakdown of the 165 violations based on the regulation violated and the average fine in FY99 for EPA region 5 (Midwest region).

Table 5-5. EPA Fine Information

Regulation	Number of DoD fines (FY96–FY00)	Average EPA Region 5 fine (FY99) (dollars)
Clean Air Act	53	83,882
Comprehensive Environmental Response, Compensation, and Liability Act	1	66,898
Clean Water Act	23	37,443
Resource Conservation and Recovery Act	85	43,445
Safe Drinking Water Act	1	7,313
Toxic Substance Control Act	2	9,141

HAZMAT Emergency Response

We researched the potential benefits of using information on material identification and product information from the MICLOG data repository in HAZMAT emergencies. We found that the potential benefits are remote.

Chem-trek, a business associated with the American Chemical Association, serves as a repository of MSDSs and emergency response services. We asked Chem-trek about the number of DoD HAZMAT-related incidents. Chem-trek reported that in calendar year 2000, the number of reported incidents was 22,000. Only 12 were DoD-related. Fire departments we contacted reported that DoD shipments account for less than 1/10 of 1 percent of incidents.

Typically, HAZMAT response teams rely on shipping papers for material identification. In a few incidents, the shipping papers are not accessible immediately. This usually occurs when a truck cab is destroyed. In those cases, material identification may take a few hours.

One fire department in a major metropolitan city said the department has material identification kits to determine the chemical make-up of material during an emergency. The fire department uses the kit in most responses to spills to verify that the carrier-provided information is correct.

Response teams indicated an interest in the information the MICLOG technology could provide in material identification; however, they also acknowledge that it would be difficult to justify the costs, despite increased safety and reliability in material identification.

Pilferage

The depots report few problems with the pilferage of HAZMAT material.

Chapter 6
Summary and Recommendation

Our research for this business case analysis clearly shows that the DLA HAZMAT supply chain can be improved. The flow of materials is frequently and seriously interrupted and delayed by missing or inaccurate product information, which then requires additional research.

In this business case analysis, we examined HAZMAT supply chain activities including identification, receipt, handling, storage, and shipment of materials. In our economic assessment, we documented costs in the current process and compared them to potential costs using the MICLOG system.

Our analysis detailed in Appendix A, indicates that the overall benefits of implementing MICLOG to the DLA HAZMAT supply chain could be substantial. Compared to the status quo, combined potential savings for DLA depots, CCPs, and service customers could be approximately $5.5 million a year after implementation. The savings are derived from elimination of additional labor and resources used to research missing HAZMAT product information and associated manual data collection and entry required for material induction into inventory.

We projected cash flow over a 15-year span from the beginning of the 5-year implementation to 10 years after full implementation. The calculated projected net present value of the program is $25.4 million.

In our sensitivity analysis presented in Appendix B, we identified five key parameters that could affect the success of the program:

- RFID tag costs
- Number of RFID tags required
- Number of HAZMAT vendors
- Volume of DLA HAZMAT supply chain shipments
- Implementation costs.

Based on our analysis, we are confident that our results show conclusively that the initiative will produce significant savings. A positive net present value is probable *if the implemented operation is similar to the concept in this report*. Our sensitivity analysis indicates significant savings are probable, even if any one of the key parameters varies significantly. However, if more than one key parameter varies greatly, the realization of these potential benefits may be jeopardized. We recommend that these key parameters be monitored closely during development and implementation to ensure program success even if multiple parameters do vary.

Appendix A

Baseline Financial Analysis

In Table A-1, we show the calculations for the undiscounted expected cash flow based on the costs and benefits described in Chapter 5. We anticipate a 5-year implementation to equip vendors and customers and a 2-year period to equip depots. The cost and benefit values are spread over 16 years, from FY02 through FY16, which extends the time horizon for 10 years after full implementation. All estimates are in FY02 dollars.

The expected cash flow is used to generate the net present value of the MICLOG initiative as shown in Table A-2. The results indicate $25.4 million in net present value over the timeframe. In addition, the initiative results in a return on investment of an estimated 1.79.

Appendix B
Sensitivity Analysis

The MICLOG business case analysis is defined by the input factors, assumptions, parameters, and underlying equations that are aimed at characterizing the DLA hazardous material supply chain. The input data are subject to many sources of uncertainty such as the absence of information, limited sample size, and subjective measurements. These factors limit our confidence in the output of the analysis. However, through this sensitivity analysis, we gained confidence that there positive benefits will result from the MICLOG initiative.

For this sensitivity analysis, we looked at the BCA output caused by the variability of input factors. By doing so, we can evaluate the effect of an input parameter on the overall benefit of the program and verify our confidence that the initiative will have positive results. We included the following input parameters in this sensitivity analysis:

- Effect of tag cost
- Number of tags associated with each shipment and receipt
- Number of DLA HAZMAT vendors
- Number of DLA HAZMAT supply chain shipments
- Estimated implementation costs.

In the following sections, we describe the effect each input could have on the output in the business case analysis.

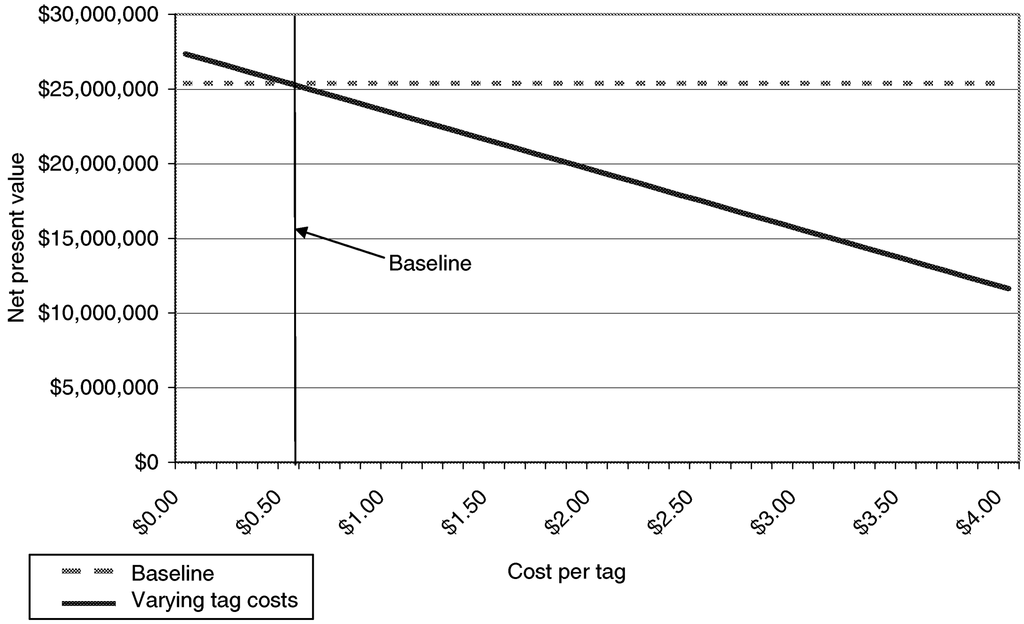
Effect of Tag Cost

We estimated that the cost of each RFID tag will be 50 cents more than the cost of current tags; however, currently there is no adequate tag available at this price. Fifty cents is a subjective estimate based on the cost of current RFID tags (a few dollars) and estimates by industry experts of the future cost of these tags (a few cents). Figure B-1 shows the effects that differing tag costs would have on the expected benefits from implementing MICLOG.

The MICLOG estimated benefits in the BCA indicate a net present value of approximately $25.3 million, assuming one tag per shipment or receipt. The analysis indicates that even if the tag cost were as much as $4 per tag, the initiative still would result in significant benefits, more than $10 million in net present value.

Therefore, the variability in tag costs within expected bounds has little effect on the desirability of the initiative.

Figure B-1. Estimated Net Present Value Based on Varying Tag Costs (Baseline=50-cent impact over current tag)

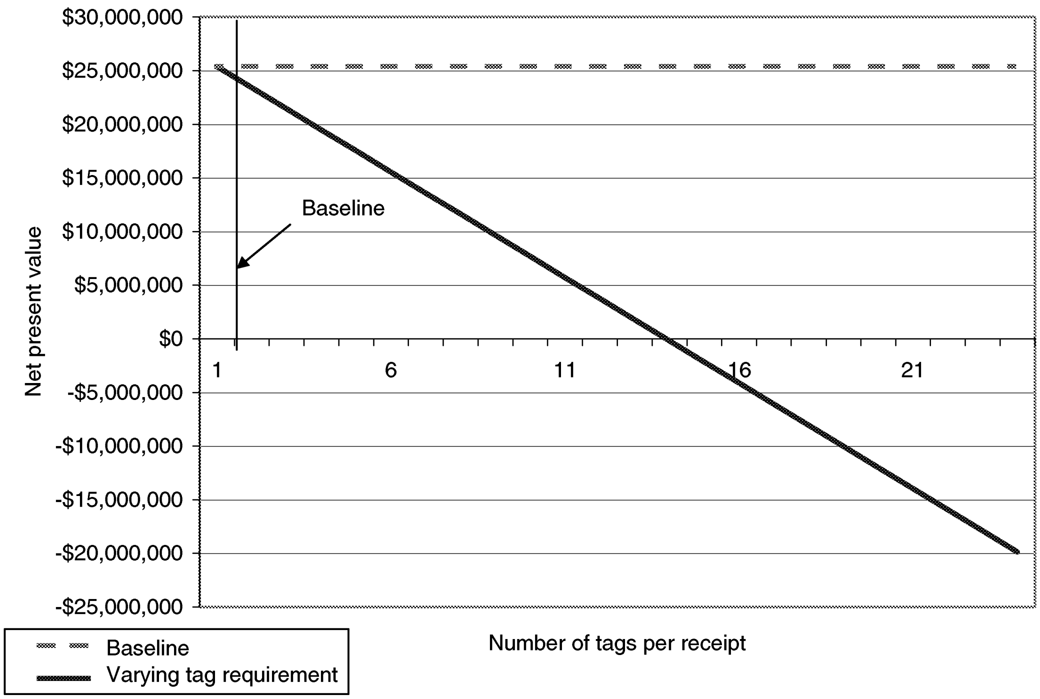


NUMBER OF TAGS ASSOCIATED WITH SHIPMENT AND RECEIPT

For the baseline, we estimated that each shipment or receipt would have one RFID tag with a 50-cent incremental cost. It is likely that the eventual operational concept would include the use of more tags per shipment, for example, one tag per box per cube side or one tag per item. Figure B-2 illustrates the effect that the number of tags has on the potential benefits of the initiative.

The analysis indicates that the implementation can accommodate up to an average of 13 tags per shipment or receipt at an incremental cost of 50 cents per tag and still result in a positive net present value. Compared to the other input parameters included in this analysis, the number of tags per shipment or receipt appears to have the greatest influence on whether the initiative will result in substantial savings to DLA.

Figure B-2. Net Present Value Based on Varying Number of Tags Per Request (Baseline=1)

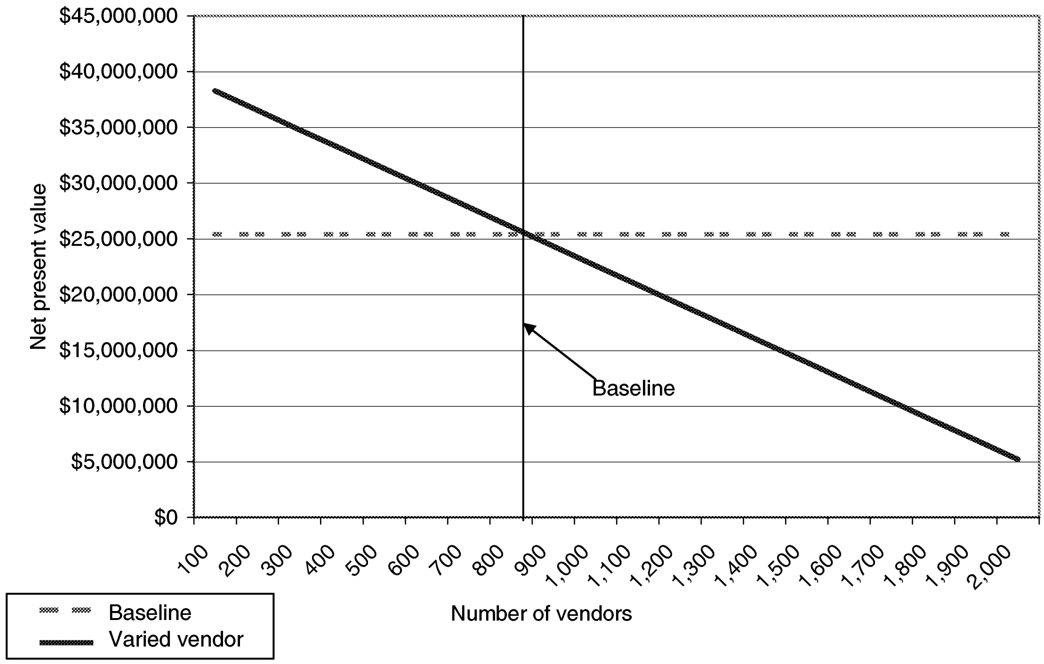


NUMBER OF HAZMAT VENDORS

The number of HAZMAT vendors used in the BCA estimate (840) was based on a survey of companies under DoD contracts that supplied potentially hazardous material over the last 3 years. Because we had to derive this number, there may be some inaccuracies associated with it; therefore, we conducted a sensitivity analysis on the cost of equipping a varied number of potential HAZMAT vendors. Figure B-3 illustrates the effect on the expected benefits of these varied costs.

This sensitivity analysis indicates that the resulting benefits of implementing MICLOG would still be significant even if the estimated number of HAZMAT vendors were two times greater than the baseline estimate of 840.

Figure B-3. Net Present Value Based on Varying Number of Vendors (Baseline Estimate 840)

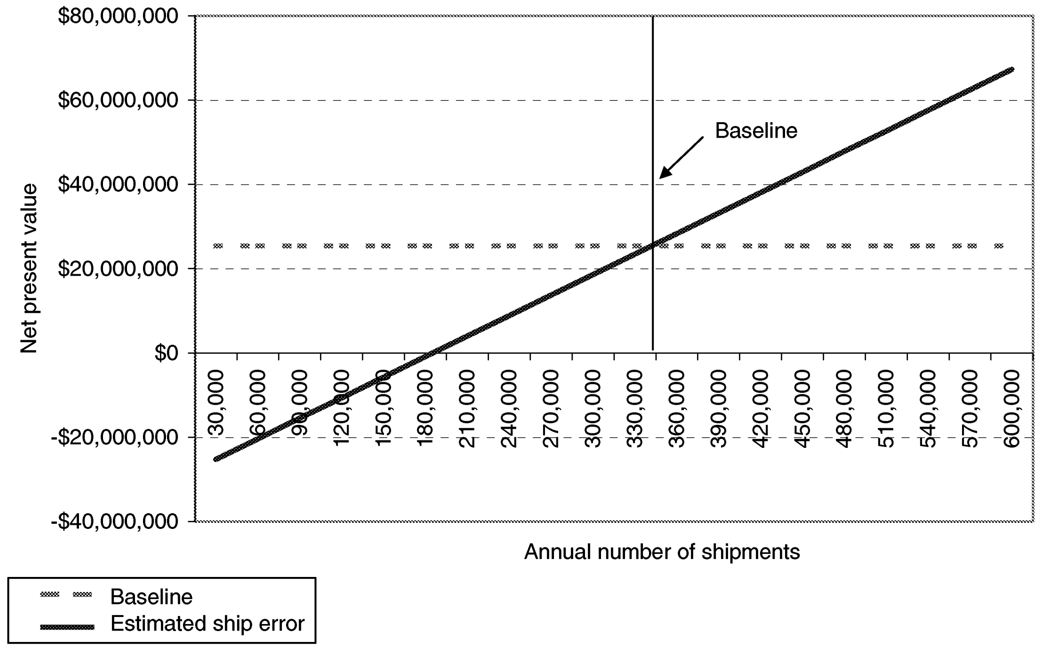


NUMBER OF HAZMAT SHIPMENTS

We used a baseline estimate of 341,900 for the annual number of HAZMAT shipments and receipts within the DLA HAZMAT supply chain. We based this estimate on FY99 DORRA data and CCP input. It includes shipments from vendor to depot, vendor to service customer, depot to service customer, service customer return to depot, and CCP receipts. Figure B-4 illustrates the estimated change in benefits by varying the number of annual HAZMAT shipments and receipts from 30,000 to 600,000.

The results indicate potential benefits even if the actual number of shipments and receipts fall to less than 250,000. It also indicates tremendous payback if the actual number of HAZMAT shipments and receipts is greater than the estimate.

Figure B-4. Net Present Value Based on Varying Number of DLA HAZMAT Supply Chain Shipment (Baseline =341,900)

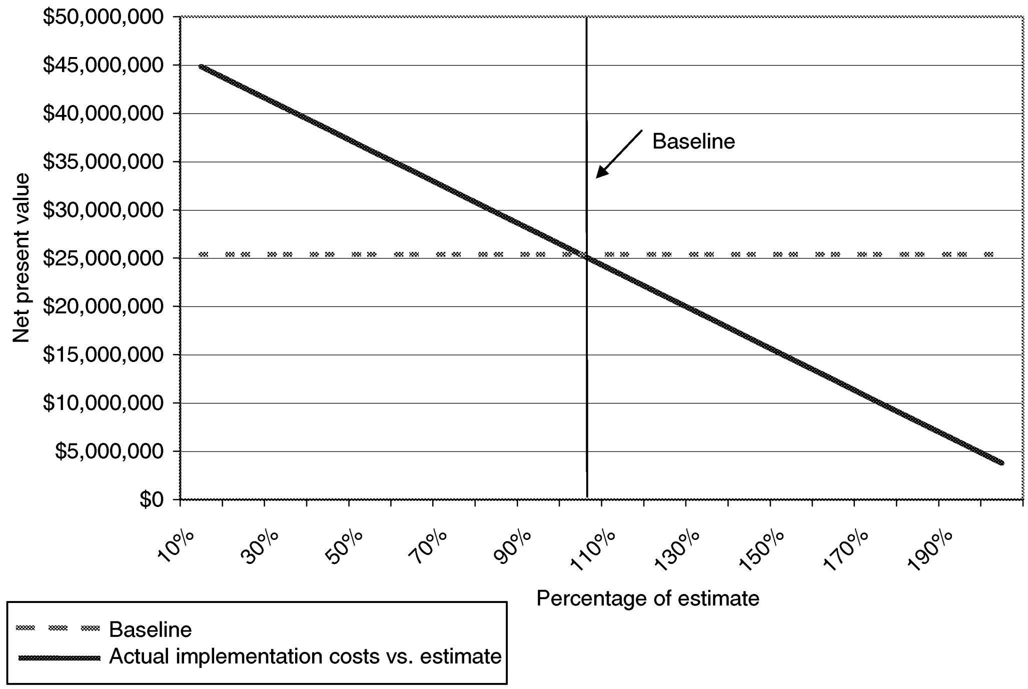


IMPLEMENTATION COSTS

We derived the baseline estimated costs of implementing the MICLOG initiative from projected equipment, labor, and travel costs, which in turn were based on projected HAZMAT activity at each location. The actual operations and layout of each facility will be the ultimate factor in determining the number and type of equipment required. Because of this uncertainty, we performed a sensitivity analysis on the potential cost of implementation. Figure B-5 illustrates the effect that the varying implementation costs could have on the expected benefits of the program.

The results of our analysis indicate that even if the actual implementation costs were two times the baseline estimate, there will be expected benefits from implementing the MICLOG initiative.

Figure B-5. Net Present Value Based on Varying Expected Implementation Costs



Appendix C
Abbreviations

AHRIST	Advanced HAZMAT Rapid Identification, Sorting, and Tracking
BCA	business case analysis
CAGE	Commercial and Government Entity
CCP	containerization and consolidation point
CONUS	continental United States
DD250	Department of Defense Form 250
DLA	Defense Logistics Agency
DORRA	DLA Office of Operations Research Analysis
DRMO	Defense Reutilization and Marketing Offices
DSCR	Defense Supply Center, Richmond
DSS	Distribution Standard System
DVD	direct vendor delivery
EPA	Environmental Protection Agency
FISC	Fleet Industrial Supply Center
FY	fiscal year
G&A	general and administrative
HAZMAT	hazardous materials
HCC	hazardous characteristics code
HMIS	Hazardous Material Information System
LMI	Logistics Management Institute

MHz	Megahertz
MICLOG	Microchip Logistics
MIS	Management Information System
MRO	material release order
MSDS	Material Safety Data Sheets
OCONUS	outside the continental United States
PC	personal computer
RFID	radio frequency identification
XML	Extensible markup language

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14. ABSTRACT
The flow of hazardous materials (HAZMAT) in the DLA supply chain suffers from inaccurate or missing product information. Resolving the interruptions caused by missing data requires manually-intensive research and work arounds. The DLA Microchip Logistics (MICLOG) program is investigating the use of an automatic data collection system to improve item tracking and access to product information, and assist in automating the inventory induction process. This study examines current DLA HAZMAT inventory management, identification, sorting and handling procedures and analyzes the potential improvements of implementing a radio frequency tag system. The results of this study indicate that there is great potential to avoid over $25 million (Net Present Value) in future DLA HAZMAT handling costs by implementing a radio frequency system.

15. SUBJECT TERMS
Automatic Identification Technology (AIT), Radio Frequency Identification Device (RFID), Microchip Logistics (MICLOG)

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